



U.S. Army Aeromedical Research Laboratory

Annual Progress Report

Calendar Year 1996

Reported by

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BACKGROUND

The U.S. Army Aeromedical Research Laboratory (USAARL) was established in 1962 to accomplish research in support of Army aviation and airborne activities, and to provide a central aeromedical research and reference library. In 1974, medical research programs in acoustics and vision were added to the Laboratory's mission. USAARL's mission was further expanded in 1977 to include the assessment of health hazards and research in support of both air and ground vehicles and weapons systems. In spite of this mission expansion, USAARL's primary mission remains medical research support of Army aviation.

Scientists and engineers assigned to USAARL seek to enhance force effectiveness by preventing or minimizing health hazards created by military systems, doctrine and tactics. Specifically, they identify, investigate and solve medical and health-related problems which deter soldiers/aviators from performing their mission or compromise their safety. Co-location with the U.S. Army Aviation Center allows USAARL's unique mix of scientific personnel to successfully conduct critical research for solving operational medicine problems for our aviators. Additionally, USAARL provides military developers with information and expertise to enhance the performance and safety of future Army systems.

USAARL maintains close coordination with other services and the international allied medical research community as a member of the North Atlantic Treaty Organization (NATO) Advisory Group for Aerospace Research and Development (AGARD), the Triservice Aeromedical Research Panel (TARP), and as a participant in the Air Standardization Coordinating Committee (ASCC).

This report presents an overview of USAARL activities during calendar year 1996 (CY96), identifies current areas of research, and gives a brief description of the research programs being conducted.

MISSION

Conducts research and development on health hazards of Army aviation, tactical combat vehicles, selected weapons systems, and airborne operations. Assesses the health hazards from noise, acceleration, impact, and visual demands of such systems and defines measures to offset hazards. Assesses stress and fatigue in personnel operating these systems and develops countermeasures. Assists in development of criteria upon which to base standards for entry and retention in Army aviation specialties. Assists other U.S. Army Medical Research and Materiel Command (USAMRMC) laboratories and institutes research on the impact of continuous operations on individual and crew performance and development of improved means of patient evacuation. Assesses current life support equipment to identify causes of failure and devises improved design. Assists the combat developers and materiel developers of new Army aviation and tactical combat vehicle systems to recognize and eliminate health hazards as early as possible in the developmental cycle. Conducts collaborative research with other Department of Defense and federal agencies on medical research and development issues of common concern.

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FROM THE COMMANDER

The United States Army Aeromedical Research Laboratory (USAARL) proudly presents this summary of achievements for calendar year 1996. This year our personnel made significant contributions to Army readiness through the continued accomplishment of our research mission.

Due to USAARL's endeavors, the flight surgeon's course and flight school now include instruction on the policies concerning pregnant soldiers in Army aviation. Results from female aviator anthropometric studies at USAARL led to changes in the configuration and design of the extreme cold weather clothing system for aircrew members.

Four USAARL researchers patented their design of a solar-powered, light emitting diode (LED) power line avoidance marker, usually referred to as a wire marker. We envision this new design mitigating one of the ever present dangers of aviation -- the inability of pilots to see utility wires.

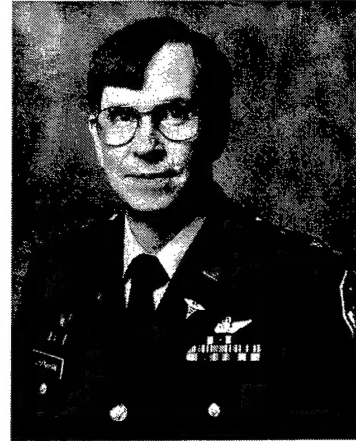
The Crew Endurance Leader's Guide, published jointly by USAARL and USASC, provides guidance to commanders, unit trainers, and safety officers to improve soldier performance, enhance mission accomplishment, and minimize crew endurance related hazards.

In response to a fatal helicopter accident, USAARL carried out a multi-phase study to examine factors that may trigger pilots to shut down the wrong engine during single-engine emergencies. Analysis shows that, when confronted with a single engine emergency, there is a 1 in 6 chance of pilot error. Training and engineering solutions to reduce the risk of error are under development.

A vibrotactile situational awareness vest was tested, demonstrating its use as a potential adjunct for preventing and recovering from spatial disorientation (SD). A novel instrument display was also designed integrating five parameters (aircraft attitude, airspeed, altitude, rate of climb/descent, and aircraft heading) into one simple display that dramatically aids simulated instrument flight and improves recovery from inadvertent unusual aircraft orientation, thus reducing the threat posed by SD.

Our scientists continue to contribute to readiness by documenting the frequency of injury and chronic disease in the Army aircrew population. They characterize the effect, determine causes, and propose strategies for prevention and screening. In 1996, researchers described aircrew injury in Army helicopter mishaps, documenting for the first time, a significant decline in both injury frequency and severity over the past 15 years.

Despite significant shortfalls in manpower and financial resources, and changes in the Army's mission, USAARL remains dedicated to the support of our customer, the combat soldier aviator. We are proud of the singular work we have accomplished on their behalf and dedicate ourselves to this continuing mission.

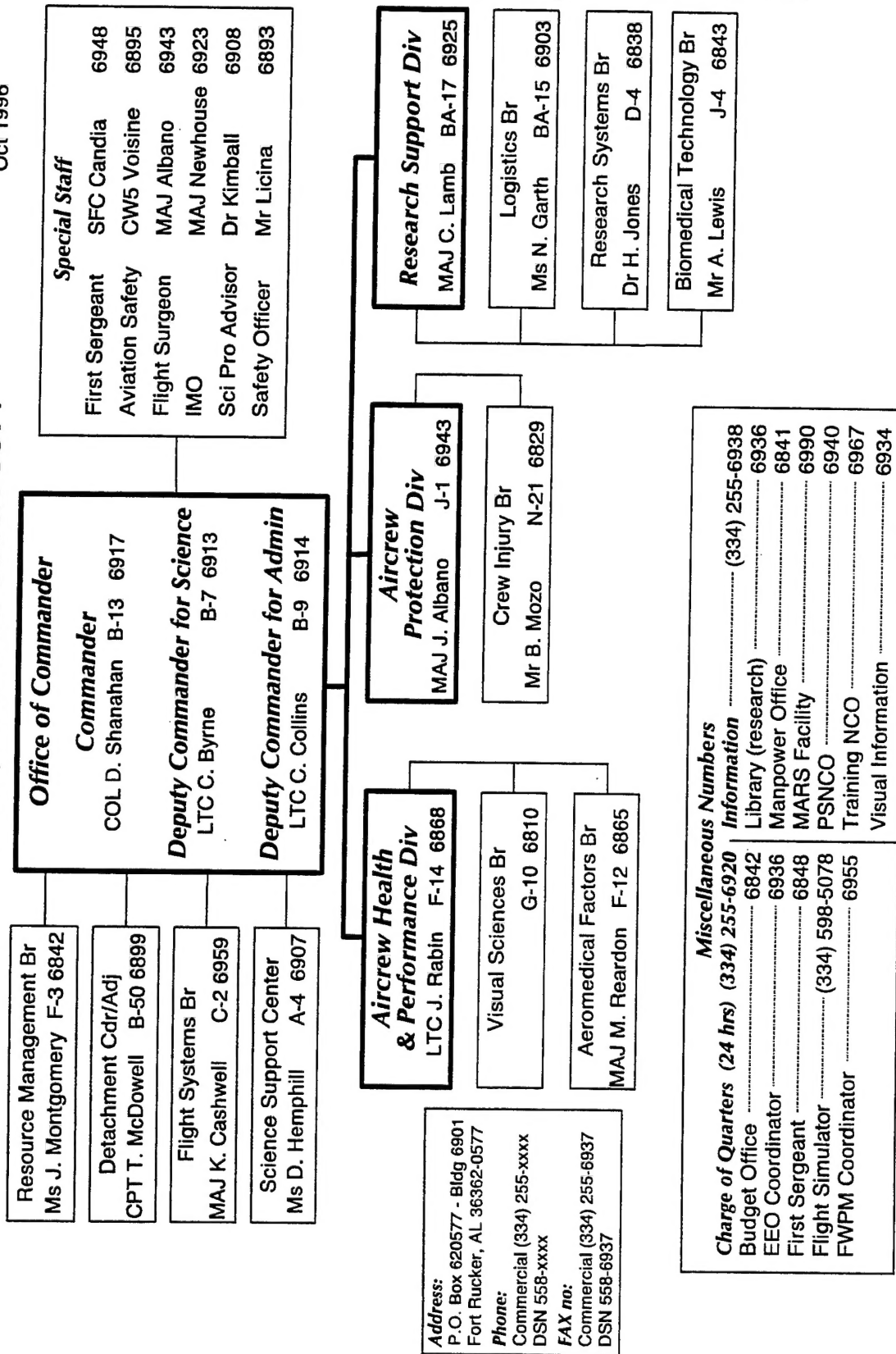


A handwritten signature in dark ink, appearing to read "Dennis F. Shanahan".

DENNIS F. SHANAHAN
Colonel, MC, MFS
Commanding

United States Army Aeromedical Research Laboratory Fort Rucker, Alabama 36362-0577

Oct 1996



PERSONNEL

As with the majority of organizations, USAARL continues to be impacted by downsizing within the Government. Continued loss of manpower authorizations, both military and civilian, deletes critical scientific skills and further intensifies the disparity between required and authorized strength levels. In order to meet continuing mission demands in light of these staffing limitations, in addition to the work force described below, USAARL added 4 temporary positions and a monthly average of 25 non-TDA personnel during CY96. Non-TDA personnel include Army student contractors, Army Research Office personnel present under the Summer Faculty and High School Math and Science Teachers Programs, and other on-site research and research support contractor personnel, exchange officers and casual officers.

Required strength was 34 officers, 2 warrant officers, 46 enlisted, and 120 civilians, for total requirements of 202. Authorized were 18 officers, 1 warrant officer, 32 enlisted, and 40 civilians for a total authorized strength of 91. The average assigned strength was 17 officers, 2 warrant officers, 41 enlisted, and 41 civilians, for a total average assigned strength of 101.

USAARL employs a highly skilled and trained work force with 67 percent of assigned employees possessing degrees. The types of degrees held by Laboratory employees in CY96 were: 4 M.D.s, 13 Ph.D./O.D.s, 9 Masters, 26 Bachelors and 8 Associate degrees.

Equal Employment Opportunity (EEO) Program:

Black Employment Program: USAARL provides a primary representative to the Fort Rucker Black Employment Program Committee (BEPC). This committee provides a forum to consider employment issues affecting blacks in the work force. The committee also works to develop and propose methods to overcome any identified barriers to employment, promotion, training, status, and recognition.

Black Civilian Employees: Three black females received a Successful 1 performance evaluation; one with a Quality Step Increase (QSI) and one with a Time Off Award (TOA). Seven classes were attended (five local and two TDY) as compared to four

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training courses (two local, one TDY and one correspondence) in CY95. As of 31 December 1996, there were 37 permanent civilian employees--three black, for a representation of 8 percent--1 percent higher than in CY95.

Hispanic Civilian Employees: The total representation of Hispanic employees is one, or 3 percent of total civilians. This is 2 percent lower than last year. This employee received a Successful 1 evaluation and a monetary award. Two courses were attended (one local and one TDY) as compared to three courses (one local and two TDY) in CY95.

Handicapped Civilian Employees: USAARL has one handicapped employee who received a Successful 1 performance rating with a QSI. This employee attended no classes as compared to three classes (one local and two TDY) in CY95.

Women Civilian Employees: One black female was nominated for the Administrative Woman of the Year award. As of 31 December 1996, there were 17 female employees out of 37 permanent civilians, for 46 percent of the total. This is up 2 percent from last year.

Of the 17 female employees, all received Successful 1 evaluations. Of the 17, 16 received either a monetary award, QSI or a TOA. Two received an additional OTS Award.

Fifteen classes were taken (13 local and 2 TDY) as compared to 24 courses (18 local, 4 TDY and 2 correspondence) in CY95.

Other Minorities: USAARL has one American Indian employee. He received a Successful 1 performance rating with a monetary award. One local training course was attended this year as compared to no classes attended during CY95.

Federal Women's Program (FWP): USAARL supports the FWP by providing a representative and an alternate to the FWP Committee (FWPC). The FWPC representative acts as an advisor to managers on the upward mobility of women in the work force. The FWPC representative monitors employment, recruitment, awards, training, and promotions, and also alerts the Command when there are under representations.

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Personnel Achievements:

Promotions: The military staff earned 11 promotions in CY96 ranging from E-5 to major. The civilian staff had three promotions of white males to Computer Specialist, GS-11; Aircraft Flight Instructor, GS-13; and Research Psychologist, GS-15.

Awards: USAARL's highly motivated, productive staff was recognized for performance in CY96 with:

Military awards:

Army Commendation Medal	10
Army Achievement Medal	9
Total	19

Civilian Awards: USAARL had an active awards program in CY96 with:

- 25 Performance Awards
- 6 Quality Step Increases
- 7 Time Off Awards
- 4 On-the-Spot Awards
- 3 Superior Civilian Service Awards
- 1 Army R&D Award
- 1 Army Aviation Medical Association Writing Award

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SCIENTIFIC PROGRAMS

USAARL scientific research encompasses three of USAMRMC's major research areas. They are systems health hazards, hazards of mechanical forces, and combat crew effectiveness. Under each of these research areas, USAARL has established scientific programs which are directed at fulfilling either an Army or a USAMRMC Scientific and Technology Objective (STO).

Titles, the DA Form 1498 accession number, and the USAARL division with the responsibility for these projects are listed below.

TITLE	DA ACCESSION NUMBER	DIVISION
Aeromedical Research of Operationally Significant Problems in the Army Aviation Environment	DAOGO151	Aircrew Health and Performance
Coping Strategies for Helicopter Pilots and Crews Involved in Night Operations	DA335655	Aircrew Health and Performance
Enhancement of Aviator Sleep and Performance Through Chemical Intervention	DA336185	Aircrew Health and Performance
Investigation of Spatial Disorientation and Related Topics	DA336186	Aircrew Health and Performance
Research Countermeasures for Significant Medical Hazards and Crew Life Support in Military Systems	DAOGO165	Aircrew Health and Performance
Aviation Epidemiology Data Register	DA308727	Aircrew Protection
Aviation Life Support Equipment Crashworthiness Evaluations	DA302870	Aircrew Protection
Biodynamics of Life Support Equipment and Personnel Armor	DAOGO167	Aircrew Protection

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Biomechanics, Simulations, Performance and Trauma Assessment and Protection from Accelerations and Repeated Impacts	DA320693	Aircrew Protection
Repeated Impact Tolerance Criteria for U.S. Army Ground Vehicles	DA336192	Aircrew Protection
Contact Lenses in Military Environments	DA306074	Aircrew Health and Performance
Military Visual Problems: Assessment, Mechanisms and Protection	DAOB6893	Aircrew Health and Performance
Visual Performance Issues of Flat Panel Technologies	DA336445	Aircrew Health and Performance
Methodologies for Assessing Retinal and Visual Function	DA336446	Aircrew Health and Performance
Develop Criteria, Models and Evaluation Methodologies to Improve Aviator Communication Performance and Hearing Protection	DA360347	Aircrew Protection
Mechanism of Melatonin Action on Military Performance	DA360560	Aircrew Health and Performance

MANAGEMENT ACTIVITIES

Technology Transfer:

USAARL maintained an active technology transfer program in CY96 through distribution of its technical reports, publication in the open literature, presentations to military and civilian audiences, execution of Cooperative Research and Development Agreements (CRDAs), and membership in federal, regional, and state technology transfer organizations.

USAARL executed the following new CRDAs in CY96:

- | | |
|-----------------------------|--|
| Bose Corp. | - Advanced Active Noise Reduction, Active Noise Cancellation (ANR/ANC) for Aviation Headsets and Microphones |
| Gentex | - Development of Advanced Active Noise Reduction and Active Noise Cancellation for Aviation Headsets and Microphones |
| Grumman | - Development of Advanced Active Noise Reduction and Active Noise Cancellation for Aviation Headsets and Microphones |
| Simula | - Research and Development on Advanced Aircrew Protection Systems |
| Allied Health Care Products | - Research, Development, Test and Evaluation on Aeromedical Evacuation Equipment |
| BCI Int. | - Research and Development on Pulse Oximeters |
| Lifecare | - Research and Development on LIFE CARE Ventilators |
| Physio-Control | - Rotary-Wing Test of LifePak 10, Model 804200-59 |

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- | | |
|-----------------|---|
| Spectrum | - Research and Development on the Spectrum 2500 Air Ambulance Modular Life Support System |
| ZOLL | - Research and Development on the Zoll PD 2000 Advisory Defibrillator/Pacer |

The following CRDAs were renewed in CY96 for an additional 2 years:

- | | |
|---------------------------|---|
| Koch & Sons | - Research and Development on Advanced Aircrew Restraint Systems |
| Old Dominion Univ. | - Research on the Effects of Helmet-Supported Devices and Muscle Fatigue on Pilot Performance |

Science Support Center:

The Science Support Center (SSC) library provided the information necessary to support the aeromedical research performed at USAARL, supported three Flight Surgeon Courses and one Aeromedical Psychologist Course, and disseminated scientific information to requesters worldwide. The library holdings are believed to comprise the most comprehensive aviation medicine collection in this part of the country.

Audiovisual and editorial services contributed to the publication of USAARL technical reports and open literature publications. These services also produced video documentaries, brochures and pamphlets describing research conducted by USAARL.

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Resources Management:

Program funding for FY96/97 (dollars in thousands):

	FY96	FY97
6.1 Basic Research	357	348
6.2 Exploratory Development	4,046	4,064
6.3 Demonstration & Validation	47	0
	-----	-----
TOTAL	4,450	4,412

Flight Activities:

Aviation support was provided by active duty aviators, mainly assigned Medical Service Corps (MSC) research aviators and Department of the Army Civilians (DAC) flying research aircraft belonging to USAARL.

Assigned aerial research platforms (aircraft) in CY96 were:

JUH-1H	71-20033
JUH-60A	88-26069
JU-21G	70-15901
C-12C	73-22265
NUH-60	Simulator

Flight hours in USAARL aircraft in CY96 were:

Fixed-wing hours	639
Rotary-wing hours	<u>464</u>
TOTAL	1,103*

*Does not include simulator flight time.

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During CY96, USAARL aviation platforms were used for the following research studies:

JUH-1H	- Telemetry and Spatial Disorientation
JUH-60A	- Dexedrine and Vibrotactile Vest
JU-21G	- Melatonin
C-12C	- Melatonin
UH-60 Research Simulator	- Air Warrior, Sleep Study, Wrong Engine Study, Novel Display, Head Tilt Study, Vibrotactile Vest, and UH-60 Single Engine Emergency Procedure Error Analysis

Two events significantly affected USAARL flight activities in CY96. First, the JU-21G was mandatorily retired and USAARL fielded a C-12C (73-22265) in April 1996. These actions happened almost simultaneously, with only about 30 days prior notice. Overall, all required operational changes, coordination, and transitions went smoothly. Since then, the C-12C has proven to be a very valuable tool in USAARL's research mission. Second, the Army directed navigation modification of the JUH-60A (an event which was still on-going at the end of CY96). This modification resulted in much non-operational time for the JUH-60A. The JUH-60A is expected to have a busy year in 1997.

Training:

USAARL's training program for CY96 included 80 training experiences. Training encompassed supervisory development training, software training, training required by Equal Employment Opportunity mandates, and training to assist employees to perform more effectively in their current positions.

RESEARCH ACTIVITIES

Aircrew Health and Performance Division:

Aeromedical Factors Branch:

Aircrew Endurance and Sustainment

Sustained and continuous operations play a critical role on the modern battlefield, but can impose sleep loss and fatigue which significantly decrease aviator performance. The Sustained Operations Team has developed numerous countermeasures to ensure that Army aviators function effectively despite the physical and psychological demands of sustained and continuous operations. Biomedical, behavioral, and psychophysiological studies are conducted to better understand the effects of stress and fatigue on aviator performance, and appropriate countermeasures are developed. This research team also investigates the efficacy of pharmacological agents for sustaining helicopter pilot performance during periods of sleep disruption or deprivation.

During 1996, the Sustained Operations Team completed the first ever in-flight study of the efficacy of dextroamphetamine for sustaining pilot performance. The team submitted five open literature papers on the use of dextroamphetamine for sustaining performance in both male and female pilots. These studies were also presented in national and international forums, including the 1996 Army Science Conference. USAARL Technical Reports detailed the efficacy of dextroamphetamine for sustaining pilot performance (TR No. 97-05), as well as the effects of the sedative triazolam on pilot performance and sleep inertia (TR No. 96-11). In addition to these completed efforts, research was initiated to evaluate the effectiveness of drug-induced prophylactic naps for sustaining performance and vigilance during periods of sleep deprivation.

Coping Strategies for Shiftlag/Jetlag

Mission-driven changes in work schedule and rapid deployment can produce stress, fatigue, and sleep deprivation which limit aircrew performance and impede the accomplishment of Army aviation missions. The Aviation Shift-Lag Team develops countermeasures to maintain aviator performance which are implemented and tested in both laboratory and field environments.

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This team also accompanies aviation units to the field, studies their work schedules and environmental conditions, evaluates their crew rest plans, and implements new strategies for future operational and training deployments. The team works in collaboration with the Federal Aviation Agency's Civil Aeromedical Institute to determine the efficacy of fatigue countermeasures on cognitive performance of air traffic control personnel working at night, international inspectors traveling across time zones, and Coast Guard personnel conducting rescue missions.

In 1996, the Aviation Shift-Lag Team conducted a field study on the use of melatonin during multiple rapid deployments and night operations. Melatonin proved to be effective for stabilizing sleep/activity rhythms and for maintaining alertness during night operations. Moreover, laboratory results showed melatonin to be effective for shifting sleep times, with minimal adverse effect on performance. Additional studies, which evaluated the effects of melatonin on the menstrual cycle and hormonal variations in females, were completed, culminating in numerous presentations, two technical reports and two open literature papers. A study on the prophylactic effect of napping was completed in conjunction with the FAA. In collaboration with the U.S. Army Safety Center, the shift-lag team also produced and distributed the Crew Endurance Leader's Guide, which specifies how stress, fatigue, lack of sleep, and shift/jet lag can be controlled and managed in military environments to improve soldier performance, enhance mission accomplishment, and minimize the risk of hazards.

Spatial Disorientation

Spatial disorientation (SD) is a contributing factor in as much as 30 percent of all Army helicopter accidents. USAARL's SD team directs its efforts at reducing the incidence of SD in Army aviation thereby enhancing flight safety and operational effectiveness. The SD research approach is comprised of three components: (1) analysis of aviation accident data to determine pilot, cockpit, mission, and environmental factors associated with SD; (2) evaluation of aids to prevent or help overcome SD in flight; and (3) development of new training and instructional methods to enhance pilot and command understanding and awareness of SD.

Over the past year, the epidemiological study of aircraft accidents was expanded to include the years 1992 to 1995. The contribution of SD to accidents remains high at 30 percent, and is responsible for an annual loss of approximately 14 lives and \$58 million. A study to examine the particularly high rate of SD accidents during night aided flight is

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under way. The aeromedical training in SD given by the U.S. Army School of Aviation Medicine (USASAM) was evaluated, and a technical memorandum of recommendations was produced. A study to assess the efficacy of spatial disorientation training sorties for enhancing aircrew awareness of SD is under way and will be completed soon. A symposium titled, "Spatial Disorientation in the Operational Rotary Wing Environment," sponsored by USASAM and chaired by the USAARL SD team leader, proved to be an extremely successful educational forum. As part of an operational, product-oriented effort to prevent SD, a prototype, integrated, USAARL-developed, flight instrument display was assessed in the Laboratory's UH-60 flight simulator. Subject pilots flew an instrument flying task and recovered from unusual attitudes. A technical report of this study, which confirms the advantage of this novel display over standard flight instruments, is under review. Protocols have been approved for three other projects which will be conducted during 1997. These include: A normative database of postural equilibrium in aviators; assessment of postural equilibrium before and after exposure to the AH-64 combat mission simulator; and an assessment of pilot head tilt during simulated day and NVG flight.

Miscellaneous Aeromedical Factors

Aeromedical human factors include a vast number of practical issues of importance to Army aviation units and personnel for preventing aircraft accidents and to assist in achieving maximum possible performance during physically and psychologically demanding mission scenarios. Hot weather is an example of an environmental stressor that can adversely affect aviator endurance and flight performance. Heat stress during aviation operations in hot weather areas is a potential hazard which can limit mission duration. A research study using USAARL's UH-60 research flight simulator was completed for the Air Warrior Program Manager to evaluate the effects of heat stress on pilots wearing the current unencumbered MOPPO aircrew battle dress uniform (ABDU) versus an encumbered MOPP4 ABDU ensemble. Mission endurance times and various measures of flight performance were significantly reduced when pilots flew the simulator in the hot condition while wearing the encumbered ensemble. A detailed technical report providing baseline data against which heat stress effects of new aviator uniforms and advanced life support equipment can be compared was published (TR No. 97-06), while a second report is in review.

Multifunction information display (MFD) and control systems are becoming increasingly common in Army helicopters, yet the cognitive and psychomotor human factor issues

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involved in their design and use have not been sufficiently delineated. Improperly designed MFDs may result in confusion and inability to navigate to the necessary display pages during emergencies or in the stress of a combat environment. Of particular concern is preventing suboptimal design of the hierarchy of data and control functions distributed over potentially hundreds of display pages. In collaboration with the Purdue University School of Applied Psychology, a quantitative algorithm was developed for the design of MFDs which simultaneously optimize cognitive and psychomotor human factors. This algorithm, which attracted considerable interest at the DOD Human Factors Engineering Technical Advisory Group Meeting, will be described fully in an upcoming technical report.

Visual Sciences Branch:

Single Engine Aircraft Emergencies

Single engine helicopter emergencies have resulted in fatal accidents. A General Officer Steering Committee requested that USAARL determine whether erroneous pilot reactions to single engine helicopter emergencies are a systemic problem, and if alternate procedures or design modifications will improve the man-machine interface. A multi-phase effort was conducted in conjunction with the U.S. Army Safety Center, including accident investigation, database search, survey, and simulator study. The results, which are being disseminated to the highest levels of the U.S. Army, indicate that when a pilot is confronted with a single engine emergency, there is a 1 in 6 chance of significant error. Training and engineering recommendations to reduce the risk of error are under review.

Contact Lenses in Military Aviation

Approximately one-third of active Army spectacle-wearing aviators are presbyopic, and therefore require bifocal correction. A four-phase study was conducted to compare performance of bifocal soft contact lens to bifocal spectacles. While vision was slightly better with spectacles, performance on flight simulation maneuvers was better with bifocal contact lenses than with spectacles. In-flight testing revealed that all pilots preferred bifocal contacts over bifocal spectacles. These findings indicate that bifocal contact lenses are an acceptable alternative to spectacles for presbyopic aviators.

Visual Performance with Electro-Optical Displays

Increasing emphasis on night and continuous operations has significantly enhanced the role of helmet-mounted visual displays for aviation and ground forces. While current systems rely on cathode ray tube (CRT) technology, flat panel displays are much lighter, thinner, and consume less power than CRTs making them well-suited for head and helmet mounted systems under development. The Visual Sciences Branch Electro-Optics Team plays a major role in evaluation of flat panel displays and prototype systems. In 1996, a survey of various flat panel display technologies was completed and published as a technical report (TR 96-19). In support of the Comanche and Army Common Helmet Programs, a detailed test plan for evaluation of developing systems was completed, and performance and health hazard guidelines for the Comanche system were revised. An extensive report on methodology for assessing integrated helmet and display systems was published (TR 96-1), as well as a report on performance specifications for the Apache helicopter display and night vision goggle systems (TR 96-13). Documents on helmet-mounted and flat panel displays were completed for NATO and presented at international meetings. A study of legibility with various displays was completed, and a report comparing dynamic visual performance of CRTs and flat panel displays was published (TR 96-36).

The expanded use of night vision devices in military and civilian environments has created a need for definitive research on applied and theoretical issues. USAARL conducts studies of visual performance with night vision devices to provide enhanced soldier-system compatibility, guidance for proper operation, and recommendations to developers of new systems. A study conducted to determine the depth of field of night vision goggles (NVGs) indicated that NVGs must be focused at a minimum distance of 50 meters to achieve optical infinity. This effort, which culminated in a practical model to predict NVG acuity for various amounts of blur, was published as a technical report (TR 96-17). An additional report on the use of counterweights by Army aviators (TR 96-30) describes the average and range of head supported weight used with NVGs. Research support for the XM-45 Aircrew Protective Mask Program included field-of-view measurements with NVGs, as well as optical evaluations of protective mask inserts and outserts. A method was developed to improve XM-45 mask compatibility with the next generation aviation helmet. A laboratory comparison between phosphors for NVGs was published in the open literature (TR 96-39), a study of the efficacy of alkaline batteries for NVGs was completed, and a project to assess peripheral visual sensitivity with night vision devices is underway.

Military Visual Tests and Performance

Selection and retention of aviation personnel is based on acceptable performance on a number of vision tests. While visual acuity remains the cornerstone of vision assessment, subtle visual loss can escape detection with standard measures of acuity. USAARL scientists developed the small letter contrast test which is more sensitive than visual acuity for detecting small amounts of blur, subtle changes in light intensity, vision with two eyes versus one, visual differences in pilot trainees, and early stages of eye disease. This research was acknowledged with an award at the Army Science Conference, and published in the open literature (TR 96-35). Currently, the small letter contrast test is being used in refractive surgery studies conducted by the Navy, Air Force, and FAA. USAARL scientists have also developed a new, computer-based approach for measuring human color vision. Unlike most clinical color tests, which simply indicate the presence of a color anomaly, this new diagnostic approach reveals type (red, green, or blue) and severity of color deficiency. This approach, which has proven to be more sensitive than standard tests for detecting color deficiency, recently was published in the open literature. Additional open literature publications include a study of military plastic sunglasses (TR 96-37), and an assessment of the effects of display color on visual performance.

Aircrew Protection Division:

USAARL's Aircrew Protection Division is a team of engineers, aviators, and health care professionals. The team studies the effects of exposure to physical forces, such as noise, repeated impact and jolt, and impact decelerations on the health and performance of Army air and ground combat crewmembers. They study communication performance and causes of chronic disease, injury, and attrition. These efforts are accomplished through computer modeling, laboratory simulation, use of crash manikins and human volunteers, investigation of mishaps, study of combat crew life support equipment, and access to crewmember health and injury databases. They recommend disease and injury prevention strategies to equipment developers and major commands.

Crash Injury and Chronic Disease Epidemiology

Epidemiology is the study of the incidence and determinants of disease. For U.S. Army aircrew, injury and disease are major causes of premature attrition from aviation service. Premature attrition results in the loss of a trained, experienced Army aviator.

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Using the Aviation Epidemiology Data Registry, Aviation Life Support Equipment Retrieval, and Army Safety Management Information System databases, USAARL researchers document the frequency of injury and chronic disease in the Army aircrew population. They characterize the effect, determine causes, and propose strategies for prevention and screening.

In 1996, researchers described aircrew injury in Army helicopter mishaps, documenting for the first time a significant decline in both injury frequency and severity over the past 15 years. USAARL researchers documented a decline in the risk of facial injury in a mishap associated with the replacement of the older PVS-5 night vision goggles with ANVIS.

Aviator Medical Selection and Retention Standards

The development of medical selection and retention criteria for Army aviators is one approach used by the Army to select and retain healthy career aviators. Medical readiness is one key component to successful military operations. USAARL researchers consult with aeromedical policy and standards makers, assisting them in the ongoing analysis of medical standards. Research efforts provide a basis of decision to continue, modify, or delete medical selection and retention methods.

In 1996, researchers documented an increased risk of traumatic injury for aviators whose sitting height exceeds 97 cm in OH-58 Kiowa mishaps. They also developed a mathematical model to predict sitting height based on stature.

Assessment of Aviation Life Support Equipment Performance

Aviation life support equipment (ALSE) includes aviation helmets and clothing, crashworthy seating, and restraint systems. A team of ALSE experts study the performance of ALSE devices recovered from aircraft mishaps. By relating investigation findings with aircrew member injury patterns, the experts propose design and operational improvements to ALSE developers and the user community.

In 1996, researchers studied the aircrew survival vest and its components in an extreme cold environment. This study and previous studies resulted in the selection of the best off-the-shelf technologies for the new AIRSAVE aviation survival vest. New technology

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had to be lighter, less bulky, and cheaper than current items while remaining as practical and effective. Researchers also conducted six field inspections of helmets and survival vests. A database containing the inspection results of over 400 subjects is being developed for analysis. Initial findings on the inspection highlight that approximately 40 percent of the crewmembers do not have their nape strap properly adjusted and approximately 20 percent of the crewmembers have improperly fitted helmets.

In 1996, 14 helmets from 6 aviation mishaps were analyzed. Four of the helmets were in support of U.S. Army Safety Center investigations which included one accident investigation. The other mishaps were investigated in conjunction with local accident investigation boards. Nine of the helmets analyzed were HGU-56/Ps that came from the second and third mishaps involving this helmet type. The ALSE Retrieval Program (ALSERP) team also developed procedures for analyzing inertia reels involved in aviation mishaps and analyzed two inertia reels from mishaps.

Development of ALSE and Crashworthiness Design Standards

Supporting the developers of Army aircraft systems and personal protection devices, such as crashworthy seating, restraints, and helmets, is an ongoing consultation and testing effort at USAARL. Through computer simulation of crashes, static and dynamic testing of systems and devices, and use of manikins and human volunteers, experts derive crash protection standards and propose product improvements to developers. USAARL engineers have designed prototype devices based on discovery of product design failures, such as a standardized restraint buckle assembly.

In 1996, USAARL researchers conducted performance assessments of the RAH-66 Comanche helmet. Analysis of the Comanche helmet data revealed a deficient chinstrap assembly, inadequate sound attenuation performance, excessive headborne weight and misplaced center of mass locations. As a result, design improvements and alternative helmet designs are being considered by the Comanche Program Manager. Flight evaluations of the MA-16 inertia reel were conducted. These tests revealed the MA-16 to be operationally suitable for use in Army aircraft. A horizontal test sled was designed and fabricated to conduct helmet dynamic stability tests and measurements of transmitted neck forces due to variability in head-worn inertia properties. This device will aid researchers in determining acceptable head-worn inertia properties and create a standardized test method for assessing helmet dynamic stability performance. A triservice Memorandum of Agreement (MOA) was coordinated for the development of a

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manikin headform. Existing manikin and test headforms are poor surrogates when assessing helmet performance. This MCA establishes the foundation for combining the interest, capabilities, and expertise of the three services to develop a realistic surrogate head.

Human Tolerance Standards for Repeated Impacts and Jolt

Combat crews riding Army helicopters and ground combat vehicles are exposed to repeated impacts and jolts. The upper limits of safe exposure to ride forces are unknown. USAARL's manrated multiaxis ride simulator (MARS) is a unique permanent facility capable of replicating the ride motion of any Army aircraft or vehicle. Human volunteers are monitored during their exposure to ride motion forces as researchers measure biomedical effects and performance. The effort is aimed at optimizing crew performance while preventing spinal injury and chronic neck and back pain. Researchers will propose safety criteria and prevention strategies to developers.

Data from the extensive human studies completed in 1995 did not identify early markers for injury due to repeated jolt. A new course of action was taken to obtain injury data. The program generated biomechanical models, computational procedures, and dose-response relationships which can be utilized to determine injury risk to soldiers exposed to repeated jolts in ground combat vehicles. Because of the new direction taken and the complexity of modeling, an extra resource year was approved. Methodologies for the health hazard analysis of repeated impact is expected in the next fiscal year. A new ISO standard in repeated impact is expected in the next few years.

Mathematical Modeling of Pilot Biodynamics

The forces and accelerations acting on the human body during a helicopter crash or inside an armored vehicle subjected to a mine blast may exceed human tolerance and produce injury to the soldier. Prediction of such injuries is the subject of mathematical simulations of crashes in which the biodynamics of the pilot are computed and the effectiveness of restraint systems is evaluated. The articulated total body (ATB) model is the primary biodynamic simulation software used in the research.

In 1996, simulations of helicopter pilot dynamics under various crash scenarios continued with the latest version of the ATB software. Evaluation of the simulated motion was

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facilitated with animation software newly developed at USAARL using virtual reality modeling language. The goal of these simulations is to study the effects of head supported devices on neck injury risk. The role of the airbag in the helicopter was examined using Dynaman, a compact version ATB software. A Cooperative Research and Development Agreement was implemented with Simula Government Products Inc., and is expected to be used in 1997 to improve the accuracy and realism of the ATB airbag model.

Acceleration Injury Assessment in Mine Blasts

The threat of injuries from landmine explosions remains a priority topic for the U.S. Army and Marine Corps. Evaluation of protective devices, from vehicle armors which protect the mounted soldier against anti-vehicle landmines, to soft armor boots which are designed to protect the dismounted soldier against antipersonnel mines, require the use of anthropomorphic surrogates. USAARL has developed a new version of the Hybrid III manikin which may be more appropriate for use in a landmine blast and other vertical impact simulation.

In 1996, USAARL provided developers of mine protection designs with expertise in evaluating the effectiveness of the design. The evaluation used assessment methodology and injury criteria derived from automotive and aviation safety fields. These methods and criteria were adapted and embedded in the BLAST computer program, a software package developed by USAARL for evaluation of mine blast tests.

Auditory Performance

In 1996, researchers assessed the effects of active noise reduction (ANR) and the communications earplug (CEP) on the communications performance and hearing protective capabilities when used in the Army aviation noise environment. Results of these studies indicate the CEP is a cost effective technique which may be used to improve the aviator's health and crew coordination abilities in the Army helicopter. A study has been initiated to determine the effects of auditory input from several radio systems which are spatially separated. If the finding shows improvements in crew coordination capabilities, further assessments in the field environment will be required.

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A protocol to evaluate the effects of ANR and CEP on the speech performance of normal and hearing impaired individuals was completed. Results show both groups perform significantly better with ANR and CEP than with the current aviator's helmet, and that hearing impaired individuals perform as well with CEP and ANR as those with normal hearing perform with the standard SPH-4B. Many of the hearing impaired aviators commented they understood speech as well as they did much earlier in their career.

This laboratory completed evaluations of ANR systems obtained under a Cooperative Research and Development Agreement (CRDA). A CRDA was established with three U.S. ANR system manufacturers for the purpose of comparing their hearing protection and voice communications performance with the HGU-56 aviator's helmet and with the CEP. Results show that ANR and CEP perform better than the passive helmet when worn alone. However, when the earseal is compromised by the use of spectacles or the CB mask, the CEP shows superior performance for both sound attenuation and speech intelligibility. This evaluation was also conducted in a number of operational helicopter environments to determine the user's view of the performance of these systems. Results indicated a majority of the aviators preferred the CEP over ANR systems.

Research efforts to improve clinical evaluation techniques which may be used to determine the aviator's auditory function and fitness to fly are continuing. The initial work is directed at providing an area of research which will be further developed by the incoming research audiologist.

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Contracts:

Through sponsorship by the U.S. Army Medical Research and Materiel Command, USAARL maintains an extramural research program in support of its in-house research. Because of manpower constraints, this program is used to provide the research data needed, as well as scientific expertise. These research contractors perform at their own facilities and, in some cases, onsite at USAARL where unique research tools and facilities can be provided at lower cost to the Army.

Present contract efforts include:

- Histological Evaluation of Inner Ears. State University of New York. Principal investigator - Dr. Roger P. Hamernik.

- Insert Protection with Communication Enhancement for High Intensity Impulse Noises Environments, Phase III; TPL, Inc. Principal investigator - David W. Cutler.

- Development of a Standard for the Health Hazard Assessment of Mechanical Shock and Repeated Impact in Army Vehicles, British Columbia Research Corporation. Principal investigator - Ms. Barbara Cameron.

- Contributive Research in Aviation Medicine, Bioengineering, Human Performance, Analytic and Modeling Systems and Data Management, Universal Energy Systems, Inc. Principal investigator - Dr. Thomas Harding.

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- 96-31. **U.S. Army Aviation Epidemiology Data Register: Distribution of sitting heights among Army aviation training applicants 1986 to 1995.** July 1996. (ADA314708)
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Caldwell, J. A. 1996. Effects of Aviator Fatigue and Some Practical Countermeasures. Presented at the International Helicopter Safety Conference, 1996 February; Lafayette, LA.

Caldwell, J. A. 1996. Workload and Performance in Helicopter Pilots. Presented to scientists of the DLR Institute of Aerospace Medicine as a consultant for the Advisory Group for Aerospace Research and Development (AGARD), 1996 February; Cologne, Germany.

Caldwell, J. A. 1996. Self-Reported Mood and CNS Measures Show Promise for Predicting Complex Performance. Presented at the American Psychological Society Eighth Annual Convention, 1996 July; San Francisco, CA.

U.S. Army Aeromedical Research Laboratory--Calendar Year 1996

- Caldwell, J. A. 1996. Effects of Fatigue and Sleep Deprivation on Aviator Performance: A Review of the Problems and Countermeasures. Presented to the Flight Surgeons Course at USASAM, 1996 August; Fort Rucker, AL.
- Caldwell, John A. 1996. Sleep, Fatigue, and Aviator Performance: Techniques for Avoiding Chronic Sleep Problems. Presented at the International Association of Safety and Survival Training Conference, 1996 October; Galveston, TX.
- Comperatore, C. A. 1996. The Army Aviation Crew Endurance Management System: A Plan for Fighter Management. Presented to attendees of the Pre-Command Course, 29 January - 8 February 1996; Fort Rucker, AL.
- Comperatore, C. A. 1996. The Army Aviation Crew Endurance Management System: A Plan for Fighter Management. Presented to attendees of the Pre-Command Course, 27 February - 7 March 1996; Fort Rucker, AL.
- Comperatore, C. A. 1996. The Army Aviation Crew Endurance Management System: A Plan for Fighter Management. Presented to attendees of the Pre-Command Course, 1 - 11 April 1996; Fort Rucker, AL.
- Comperatore, C. A. 1996. The Army Aviation Crew Endurance Management System: A Plan for Fighter Management. Presented to attendees of the AMEDD Pre-Command Course, 1996 May; Fort Rucker, AL.
- Comperatore, C. A. 1996. The Army Aviation Crew Endurance Management System: A Plan for Fighter Management. Presented to attendees of the Pre-Command Course, 16 - 26 September 1996; Fort Rucker, AL.
- Comperatore, C. A. 1996. The Army Aviation Crew Endurance Management System: A Plan for Fighter Management. Presented to attendees of the Aviation Officer Advanced Course, 1996 May; Fort Rucker, AL.
- Comperatore, C. A. 1996. The Army Aviation Crew Endurance Management System: A Plan for Fighter Management. Presented to attendees of the Aviation Officer Advanced Course, 1996 June; Fort Rucker, AL.

U.S. Army Aeromedical Research Laboratory--Calendar Year 1996

- Comperatore, C. A. 1996. The Army Aviation Crew Endurance Management System: A Plan for Fighter Management. Presented to attendees of the Aviation Officer Advanced Course, 1996 July; Fort Rucker, AL.**
- Comperatore, C. A. 1996. The Army Aviation Crew Endurance Management System: A Plan for Fighter Management. Presented to attendees of the Warrant Officer Advanced Course, 5 February 1996; Fort Rucker, AL.**
- Comperatore, C. A. 1996. The Army Aviation Crew Endurance Management System: A Plan for Fighter Management. Presented to attendees of the Warrant Officer Advanced Course, 28 February 1996; Fort Rucker, AL.**
- Comperatore, C. A. 1996. The Army Aviation Crew Endurance Management System: A Plan for Fighter Management. Presented to attendees of the Warrant Officer Advanced Course, 1996 April; Fort Rucker, AL.**
- Comperatore, C. A. 1996. The Army Aviation Crew Endurance Management System: A Plan for Fighter Management. Presented to attendees of the Warrant Officer Advanced Course, 2 May 1996; Fort Rucker, AL.**
- Comperatore, C. A. 1996. The Army Aviation Crew Endurance Management System: A Plan for Fighter Management. Presented to attendees of the Warrant Officer Advanced Course, 30 May 1996; Fort Rucker, AL.**
- Comperatore, C. A. 1996. The Army Aviation Crew Endurance Management System: A Plan for Fighter Management. Presented to attendees of the Warrant Officer Advanced Course, 1996 June; Fort Rucker, AL.**
- Comperatore, C. A. 1996. The Army Aviation Crew Endurance Management System: A Plan for Fighter Management. Presented to attendees of the Warrant Officer Advanced Course, 1996 August; Fort Rucker, AL.**
- Comperatore, C. A. 1996. The Army Aviation Crew Endurance Management System: A Plan for Fighter Management. Presented to attendees of the Warrant Officer Advanced Course, 1996 September; Fort Rucker, AL.**

U.S. Army Aeromedical Research Laboratory--Calendar Year 1996

Comperatore, C. A. 1996. The Army Aviation Crew Endurance Management System: A Plan for Fighter Management. Presented to attendees of the Aviation Safety Officer Course, 1996 February; Fort Rucker, AL.

Comperatore, C. A. 1996. The Army Aviation Crew Endurance Management System: A Plan for Fighter Management. Presented to attendees of the Aviation Safety Officer Course, 1996 May; Fort Rucker, AL.

Comperatore, C. A. 1996. The Army Aviation Crew Endurance Management System: A Plan for Fighter Management. Presented to attendees of the Aviation Safety Officer Course, 1996 November; Fort Rucker, AL.

Comperatore, C. A. 1996. The Effects of a 7-day Melatonin Regimen on Vigilance During the Early Follicular and Late Phase of the Menstrual Cycle. Presented at the 104th Convention of the American Psychological Association, 1996 August; Toronto, Ontario, Canada.

Comperatore, C. A. 1996. Sleep Deprivation. Presented at the North Carolina Army National Guard Aviation Safety Conference, 1996 December, Salisbury, NC.

Comperatore, C. A. 1996. Melatonin Action in Humans. Alternate chair/discussion leader at 1996 Gordon Research Conference on Pineal Cell Biology, 1996 February; Ventura, CA.

Comperatore, C. A. 1996. Fighter Management and the Crew Endurance Management System. Presented to the Advanced Course of the Army War College, 1996 April; Carlisle Barracks, PA.

Comperatore, C. A., Della Rocco, P. 1996. Desynchronization Prevention in Civilian and Military Aviation: A Discussion Panel. Presented as a discussion panel at the 1996 Annual Scientific Meeting of the Aerospace Medical Association, 1996 May; Atlanta, GA.

Comperatore, C. A., Allan, L. W., Allan, C. M., Ferry, C. J. 1996. Desynchronization Prevention in Army Aviation Missions. Presented at the 1996 Annual Scientific Meeting of the Aerospace Medical Association, 1996 May; Atlanta, GA.

U.S. Army Aeromedical Research Laboratory--Calendar Year 1996

- Comperatore, C. A. 1996. Fighter Management and the Crew Endurance Management System. Presented at the 229th Regiment Aviation Safety Day, 1996 July; Fort Bragg, NC.
- Comperatore, C. A. 1996. Effects of Melatonin on Human Sleep and Performance. Invited discussant for a Satellite Symposium to the European Sleep Research Society Meeting, 1996 June; Brussels, Belgium.
- Della Rocco, P., Comperatore, C. A. 1996. Napping as a Countermeasure to Sleepiness on the Night Shift: A Preliminary Report. Presented at the 1996 Annual Scientific Meeting of the Aerospace Medical Association, 1996 May; Atlanta, GA.
- Ivey, Rebecca H., Rash, Clarence E., Levine, Richard R., Wentworth, Sean L, McGowin, Everette. 1996. Utilization of Visual Ports in U.S. Army Rotary-Wing Aircraft. Presented at 52nd Annual Forum, American Helicopter Society, 1996 June; Washington, DC.
- Kirby, A. W., Crowley, J. S., Albano, J. P., Comperatore, C. A. 1996. Effects of Bedtime Administration of Melatonin Menstrual Characteristics and Cognitive Performance. Presented at the 1996 Annual Scientific Meeting of the Aerospace Medical Association, 1996 May; Atlanta, GA.
- Meeks, M., Allan, L W., Levine, R. R., Comperatore, C. A. 1996. Getting Quality in Hot Desert Conditions After Early Morning Attack Missions: A Feasibility Study. Presented at the 1996 Annual Scientific Meeting of the Aerospace Medical Association, 1996 May, Atlanta, GA.
- Rabin, J. C., Kotulak, J. C., Morse, S. E. 1996. Combating Night Myopia. Presented at the 20th Annual Army Science Conference, 24-27 Jun 96, 1996 June; Norfolk, VA.
- Rabin, J. C. 1996. Measuring Visual Resolution in the Contrast Domain: The Small Letter Contrast Test. Presented at the 20th Annual Army Science Conference, 24-27 June 1996, 1996 June; Norfolk, VA.
- Rabin, J. C., McLean, W. E. 1996. A Comparison Between Phosphors for Night Vision Goggles. Presented at the 1996 Annual Scientific Meeting of the Aerospace Medical Association, 1996 May; Atlanta, GA.

U.S. Army Aeromedical Research Laboratory--Calendar Year 1996

- Rabin, J. C. 1996. Visual Performance Assessment of Helmet Mounted Displays. Presented at the 1996 Annual Scientific Meeting of the Aerospace Medical Association, 1996 May; Atlanta, GA.
- Rabin, J. C. 1996. Spatial Measures of Color Vision: Comparison Between Visual Acuity and Contrast Sensitivity. Presented at the Annual Scientific Meeting of the American Academy of Optometry, 8 December 1996; Orlando, FL.
- Rash, C. E., Levine, R. R., Albano, J. P. 1996. Integration of Flat Panel Display Technologies with Telemedicine Applications. Presented at the 1996 Annual Scientific Meeting of the Aerospace Medical Association, 1996 May; Atlanta, GA.
- Rash, Clarence E. 1996. NATO Study on Performance Specifications of Flat Panel Displays. Presented Agency for Standardization (MAS), Aircraft Instruments and Aircrew Stations (AI) Working Party (WP), 1996 June; Brussels, Belgium.
- Rash, C. E., Harding, T. H., Beasley, H. H., Martin, J. S. 1996. A Characterization of IHADDs Performance. Presented at the SPIE Conference, 1996 April; Orlando, FL.
- Reardon, M. J. 1996. Preventing the Hazards of Heat Stress in Hot Weather Operations. Presented at the International Helicopter Safety Conference, 1996 February; Lafayette, LA.
- Reardon, M. J. 1996. Heat Stress in Aviation Operations. Presented at a Mexican Military Medicine Conference as part of the U.S. Army OTSG Subject Matter Expert Exchange Program, 1996 August; Hermosillo, Mexico.
- Reardon, M. J. 1996. The Physiological and Medical Effects of Cold Water Immersion. Presented at the 4th Annual International Association for Sea Survival Training Conference, 1996 October; Galveston, TX.
- Wiley, R. W., Rabin, J. C. 1996. Comparison Between Dynamic Visual Performance of CRTs and LCDS. Presented at the 1996 Annual Scientific Meeting of the Aerospace Medical Association, 1996 May; Atlanta, GA.
- Alem, Nabih M. 1996. Using ATB to Model Bread-Away Head-Supported Devices. Presented at the 1996 ATB User's Group Conference, 1996 February; Phoenix, AZ.

U.S. Army Aeromedical Research Laboratory--Calendar Year 1996

Alem, Nabih M. 1996. Biodynamic Simulations of Pilot Head Impact with a Helicopter Multi-Airbag System. Presented at the Advisory Group for Aerospace Research and Development Specialist Meeting on Impact Head Injury, 7-8 November 1996; Alamogordo, NM.

Alem, Nabih M. 1996. Acceleration Injuries: Assessment Methods and Criteria. Presented to the Technical Cooperation Program, Working Technical Panel (WTP) 1, Key Technical Area (KTA) 1-29, "Protection of Wheeled Vehicle Occupants from Landmine Effects," 1996 April; Melbourne, Australia.

Alem, Nabih M. 1996. BLAST Software demonstration. Presented to the Technical Cooperation Program, Working Technical Panel (WTP) 1, Key Technical Area (KTA) 1-29, "Protection of Wheeled Vehicle Occupants from Landmine Effects," 1996 April; Melbourne, Australia.

Licina, Joseph R. 1996. U.S. Army Aeromedical Testing and Evaluation for MEDEVAC Operations. Presented at the U.S. Army Aeromedical Commanders' Conference, 1996 March; San Antonio, TX.

Licina, Joseph R., Carson, Elizabeth A. 1996. U.S. Army Female Aviation Anthropometric Clothing and Cockpit Compatibility Assessments/Confounding Factors within Emerging Results. Presented at the 1996 Annual Scientific Meeting of the Aerospace Medical Association, 1996 May; Atlanta, GA.

Licina, Joseph R. 1996. Safety Issues in MEDEVAC Operations. Presented to the Air Ambulance Issues Panel at the 1996 Annual Scientific Meeting of the Aerospace Medical Association, 1996 May; Atlanta, GA.

Mason, Kevin T. 1996. Women in the Cockpit: Research Findings of the Aircrew Protection Division. Presented by invitation, 1996 Women in Army Aviation Symposium, 1996 February; Fort Rucker, AL.

McEntire, B. J., Smith, Kent F., Rapaport, Martin B. 1996. The Case for Supplemental Cockpit Crew Restraint in Military Helicopters. Presented at the American Helicopter Society 52nd Annual Forum, 4-6 June 1996; Washington, DC.

U.S. Army Aeromedical Research Laboratory--Calendar Year 1996

- McEntire, B. J., Shanahan, D. F. 1996. Mass Requirements for Helicopter Aircrew Helmets. Presented to the AGARD Conference on Impact Injury Responses, Mechanisms, Tolerance, Treatment and Countermeasures, 1996 November; Alamogordo, NM.
- McEntire, B. J. 1996. U.S. Army Aircrew Helmets: Head Injury Mitigation Technology. Presented at the AGARD Specialist Meeting on Impact Head Injury Responses, Mechanisms, Tolerance, Treatment and Countermeasures, 1996 November; Alamogordo, NM.
- McEntire, B. J., Smith, Christopher. 1996. Applicability of Cockpit Airbags to the AH-64. Presented to members of ODCSOPS at the Pentagon, 1996 October; Washington DC.
- Mozo, Ben T., Ribera, John E. 1996. CEP: A Logical Choice for Voice Communications in Aircraft. Presented at Advisory Group for Aerospace Research and Development (AGARD) Aerospace Medical Panel Symposium on "Audio Effectiveness in Aviation," 1996 October; Copenhagen, Denmark.
- Mozo, Ben T., Ribera, John A., Staton, Robert N. 1996. Laboratory Results of Active Noise Reduction and Communications Earplug Assessments. Presented to the Triservice Noise Reduction Working Group at USAARL, 1996 April; Fort Rucker, AL.
- Mozo, Ben T. and Staton, Robert N. 1996. Results of Cooperative Research and Development Agreement Study. Presented to the 160th SOAR(A), Hunter AAF, 1996 December; Savannah, GA.
- Ribera, John A., Mozo, Ben T. 1996. Current Communications Earplug (CEP) Research. Presented to the Joint Aircrew Systems Executive Steering Committee, 1996 May; San Antonio, TX.
- Shannon, Samuel G., Albano, John P., Licina, Joseph R. 1996. Head Injury Risk in U.S. Army Rotary-Wing Mishaps: Changes since 1980. Presented to the AGARD Specialist Meeting on Impact Head Injury Responses, Mechanisms, Tolerance, Treatment and Countermeasures, 1996 November; Alamogordo, NM.

U.S. Army Aeromedical Research Laboratory--Calendar Year 1996

Voisine, Joel J. 1996. ALSE/ALSERP, a USAARL Perspective. Presented by invitation to the Iowa National Guard in support of their annual Aviation Safety Day, 1996 February; Des Moines, IA.

Voisine, Joel J. 1996. ALSE/ALSERP, a USAARL Perspective. Presented by invitation to the Fifth Army Aviation Safety and Standardization Conference, 1996 February; San Antonio, TX.

U.S. Army Aeromedical Research Laboratory--Calendar Year 1996

Committees:

Aerospace Medical Association

Membership Committee	Member	COL D. F. Shanahan
Scientific Program Committee	Member	COL D. F. Shanahan
	Member	Dr. K. A. Kimball
	Member	CPT R. M. Wildzunas
Science and Technology Committee	Member	Dr. K. A. Kimball
	Member	Dr. C. A. Comperatore
Aerospace Human Factors Association	President	Dr. K. A. Kimball
	Member	Dr. C. A. Comperatore
Ad Hoc Human Factors Committee	Member	Dr. K. A. Kimball
	Member	CPT R. M. Wildzunas
Registration Committee	Member	CPT R. M. Wildzunas

Federal Laboratory Consortium

Member	Ms. D. L. Hemphill
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American National Standards Institute

S12 Noise	USAARL Rep.	Mr. B. T. Mozo
Z90.1 Helmet Committee	Member	Mr. B. J. McEntire
S12 WG10 Working Group on Hearing Protector Attenuation	Member	Mr. B. T. Mozo
S12 WG11 Working Group on Field Effectiveness & Physical Charac- teristics of Hearing Protectors	Member	Mr. B. T. Mozo
S12 WG29 Working Group on Assessment Methodologies for Nonlinear Hearing Protection	Member	Mr. B. T. Mozo

Department of Defense

Joint Service Display Panel Subpanel on Display Devices	Member	Mr. C. E. Rash
Human Factors Engineering Technical Advisory Group (Triservice)	Member	Dr. K. A. Kimball
Controls, Displays, and Interactive Systems Group	Member	CPT R. M. Wildzunas
	Chairman	CPT R. M. Wildzunas

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National Safety Council Executive Board, Aerospace Division	Member	Mr. J. R. Licina
Continuous/Sustained Operations Subgroup of DOD HFE TG	Member Member	Dr. J. A. Caldwell Dr. C. A. Comperatore
Triservice Aeromedical Research Panel (TARP)	Chairman	COL D. F. Shanahan
Triservice Vision Technical Working Group (TARP)	Chairman	LTC J. C. Rabin
Therapeutically and Operationally Important Medications Working Group	Chairman	Dr. C. A. Comperatore
Technical Working Group in Situational Awareness and Spatial Disorientation	Member	LTC M. G. Braithwaite
Triservice Aviator Helmet Standardization Working Group	Member Member	Mr. J. R. Licina Mr. B. J. McEntire
Joint Aircrew Executive Steering Committee Triservice Noise Reduction Working Group	Member	Mr. B. T. Mozo
Joint Cockpit Airbag System Working Group	Member	Mr. B. J. McEntire
Triservice Biodynamics Working Group	Chairman Member Member	MAJ J. Albano Dr. N. M. Alem Mr. B. J. McEntire
Joint Service General Purpose Mask Working Group	Member (Non-Voting)	Dr. W. E. McLean
National Sleep Foundation Speaker Bureau	Member	Dr. J. A. Caldwell

Department of the Army

USA ALSE Steering Council	Member	Mr. J. R. Licina
RAH-66 Comanche Group	Member	Mr. J. R. Licina
Life Support Equipment Steering Committee	Member	Mr. J. R. Licina

U.S. Army Aeromedical Research Laboratory--Calendar Year 1996

RAH-66 Comanche System Safety Working Group	Member	Mr. J. R. Licina
Joint Aircrew Executive Steering Council (JAESC)	Member	Mr. B. J. McEntire
Rotorcraft Pilot's Association (RPA) Executive Steering Council	Member Consultant	COL D. F. Shanahan LTC R. R. Levine
Team Air Warrior Management Working Group	Assoc. Member Alternate	LTC C. D. Byrne Mr. J. R. Licina
AH-64 and Longbow System Safety Working Group	Member	Mr. J. R. Licina
Kiowa Warrior, OH-58D, and MPLH System Safety Working Groups	Member	Mr. J. R. Licina
XM-45 Aircrew Protective Mask Test Integration Working Group	Member	Dr. W. E. McLean
HGU-56/P Comanche Compatibility Development Program	Member	Mr. C. E. Rash
U.S. Army Aviation Contact Lens Policy Working Group	Co-Chairman	CPT G. C. Hendricks
Advanced Laser Protection System (ALPS) Working Group	Member	Dr. W. E. McLean
U.S. Army Aviation Center		
Life Support Equipment Steering Committee	Member	Mr. J. R. Licina
U.S. Army Aeromedical Consultant Advisory Panel, USAAMC	Member	MAJ J. A. Albano
Black Employment Program Committee	Alternate	Ms. E. Gordon

International Committees

North Atlantic Treaty Organization

Advisory Group for Aerospace Research and Development (AGARD) Aerospace Medical Panel (AMP)	Member	COL D. F. Shanahan
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Aircraft Instrument Working Party	Member	Mr. C. E. Rash
Air Standardization Coordinating Committee		
Aerospace Medicine and Life Support Systems Working Party 61	Delegate Alternate Delegate	COL D. F. Shanahan Dr. K. A. Kimball
Aeromedical Aspects of Crash Protection, Escape, and Survival Equipment Project Group 102	Project Officer	Mr. J. R. Licina
Aeromedical Aspects of Biodynamics Stress Project Group 103	Project Officer	Mr. B. T. Mozo
Aeromedical Aspects of Vision and Visual Enhancement in Air Operations Project Group 113	Project Officer	LTC J. C. Rabin
WP61 for Spatial Disorientation	Consultant	LTC M. G. Braithwaite
The Technical Cooperation Program		
Subgroup U, UTP-7, Human Factors in Aircraft Environments	Army Representative	LTC R. R. Levine
Working Technical Panel (WTP) 1 Key Technical Area (KTA) 1-29 Protection of Wheeled Vehicle Occupants from Landmine Effects	Member	Dr. N. M. Alem